#6/Sub. Spec.

Appendix 2
New Pages 1, 2, 4, 5, 6, 10 and 13
Of The Specification:

FUEL INJECTION DEVICE WITH MAGNET VALVE DAMPED IN BOTH LAMINAR AND TURBULENT FASHION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a 35 USC 371 application of PCT/DE 00/04587 filed on December 22, 2000.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention is based on a fuel injection device, having a magnet valve for controlling fuel flows, which valve, in at least one of its positions, closes a damping chamber in the magnet valve that communicates constantly with a relief chamber via a damping throttle.

DESCRIPTION OF THE PRIOR ART

A fuel injection device of the type with this invention is concerned is known from Published, Nonexamined German Patent Application DE-OS 196 16 084 A1, employs an insert piece with a through bore acting as a damping throttle between the damping chamber and the relief chamber. The damping performance of this through bore is not always satisfactory. Moreover, the installation space required for the insert piece is comparatively great.

OBJECTS AND SUMMARY OF THE INVENTION

The primary object of the invention is to furnish a fuel injection device with further improved performance.

According to the invention, this object is attained with a fuel injection device, having a magnet valve for controlling fuel flows, which valve, in at least one of its positions, closes a damping chamber in the magnet valve that communicates constantly with a relief chamber via a damping throttle, and

in which the damping throttle throttles in both laminar fashion and turbulent fashion.

SUMMARY OF THE INVENTION

By this provision, the damping performance of the damping throttle can be adapted to the requirements of the fuel injection system within wider limits compared to the prior art. As a consequence, because of the use of the damping throttle of the invention, the waviness of the characteristic curves of a fuel injection device of the invention is decreased markedly. Furthermore, the characteristic curves of the fuel injection device of the invention become smooth. Both effects contribute to improving the performance of the fuel injection system. Furthermore, by the use of the damping throttle of the invention, the variations between different examples of a structurally identical fuel injection device are reduced, so that the variation in operating performance of internal combustion engines equipped with the fuel injection devices of the invention is reduced as well.

In a variant of the invention, it is provided that the damping throttle is embodied in a support plate, which is disposed between the damping chamber and the relief chamber and which closes off the damping chamber toward the relief chamber, so that a very compact design, because it is shallow in structure, is possible.

result of these designs, especially good damping performance of the laminar throttle and the damping throttle overall can be attained. The use of a round indentation, with a depth of 0.1 to 0.2 mm and disposed substantially concentrically to the through bore has proved to be especially advantageous.

In a further feature of the invention, the indentation is disposed in such a way that it intersects at least one recess in the support plate, so that a communication always exists from the damping chamber to the relief chamber, via the gap formed by the indentation and the electromagnet and via the recess.

In a further feature of the invention, the support plate is mounted detachably in the fuel injection device, so that by simply replacing the support plate, the damping performance of the fuel injection device can be changed and improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages and advantageous features of the invention can be learned from the ensuing description, taken with the drawings, in which:

Fig. 1 is a cross section through a fuel injection device of the invention;

Fig. 2 is an enlarged view of the detail X of Fig. 1;

Figs. 3 a, 3b and 3c are a cross section and two views from below of a support plate; and

Figs. 4a and 4b are two further views from below of a support plate.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows part of a distributor injection pump, as a fuel injection device of the invention, in section. In a housing 1 of the fuel injection pump, a bush 2 is inserted, which in turn in its interior has a guide bore 5, in which a distributor 7 is guided. The distributor is driven to rotate by means not otherwise shown and revolves in synchronism with the rpm of an associated internal combustion engine. It is axially secured against displacement in the housing 1 and has a longitudinal conduit 8, which communicates on one side with a pump work chamber, not shown further here, and on the other side discharges into a pressure chamber 9, which is part of a conduit 12 that originates on one face end 10 of the distributor 7 and ends blind and is coaxial to the distributor. The pressure chamber 9 is defined on one side by a valve seat 14, which changes over into a partial bore 15

extending onward on the relief side of the conduit 12. The other side of the pressure chamber 9 is adjoined by a coaxial guide bore 16, which emerges at the face end 10 of the distributor 7.

A magnet disk 18 and a shim 19 are screwed onto this face 10. The shim 19 has a keyhole-shaped recess 20. A neck 22 of a valve member 23 of a magnet valve 24 protrudes through a narrow portion of the recess 20 that is coaxial to the distributor. The magnet valve is inserted with its housing 25 into the housing 1 of the fuel injection pump and is fixed there in stationary fashion. In its housing 25, the magnet valve 24 has an electromagnet 29 with a magnet coil 26, which is disposed inside a magnet core 27, which takes the form of a ring-shaped cup, with a middle, sleevelike magnet core 27 and an outer magnet jacket 28, between which and the middle magnet core 27 the magnet coil 26 is supported. On the face end toward the distributor 7, the magnet core 27 is supplemented with the magnet disk 18, which is adapted in diameter to the inside diameter of the outer magnet jacket 28 and with the latter forms only a narrow air gap. As a result, while the electromagnet 29 is stationary, the magnet disk 18, which is part of the magnetic circuit, can rotate together with the rotating distributor 7.

The middle magnet core 27 has a continuous recess 30, which serves as a guide 31 for a plunging armature 33. This armature is secured to a headlike end 34, adjacent to the neck

are circular, which has proved to be especially advantageous. The countersunk recess 47 is shown in Fig. 4b.

With the fuel injection device described above and the associated magnet valve, an exact fuel quantity control is obtained, in particular in the case contemplated here in which, with the aid of the magnet valve, the high-pressure pumping phase along with the injection onset and injection duration of the fuel injection pump is determined. Via the rotating distributor, and via a respective supply line 43, the associated fuel injection valve is triggered and supplied with the high-pressure injection quantity controlled by the magnet valve 24. With only slight mass, the magnet valve is very fast and vibration-free, with the optimally adaptable damping contemplated here.

The foregoing relates to preferred exemplary embodiment of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.